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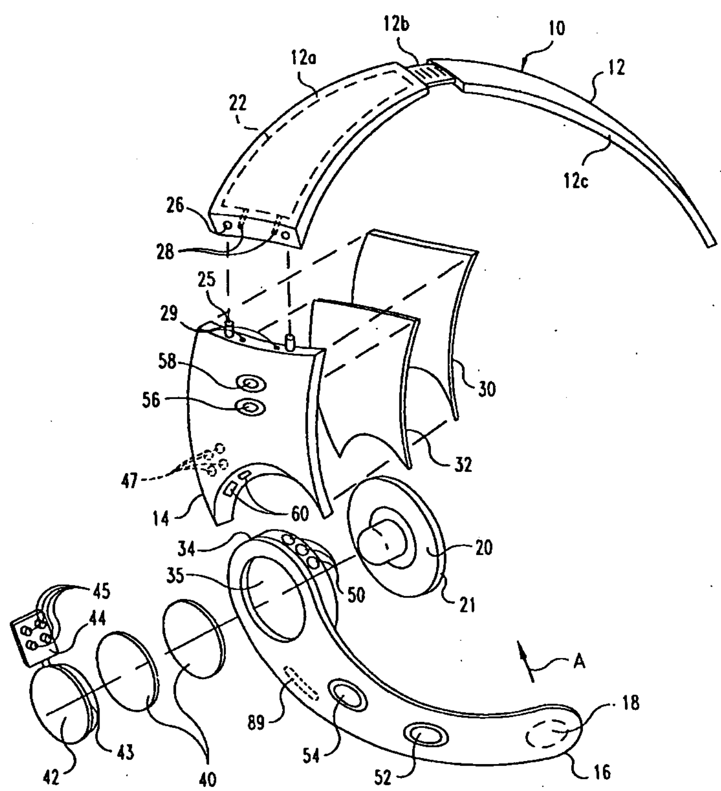
(54) Title: WEARABLE TELECOMMUNICATIONS APPARATUS WITH VOISE/SPEECH CONTROL FEATURES

(57) Abstract

A wearable communication apparatus in the form of telephone headset (10) includes antenna (22), power supply (40) and electronics housing (14) for on–board electronics for RF and IR communications. Headset (10) includes mouthpiece (16) rotatably mounted to electronics housing (14). The mouthpiece includes ear speaker (20), microphone (18) and rechargeable batteries (40). Electrical contact array (50) at the end of the rotating part of mouthpiece (16) connects to electrical contact array (60) at the bottom of electronics housing (14) and activates electronics housing (14) when mouthpiece (6) is rotated into a speaking position. In deactivated position electrical contact array (50) engages complementary contact array (80) in base unit (70) for recharging as indicated by the illumination of indicator light (82).



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Wearable Telecommunications Apparatus With Voice/Speech Control Features

Reference to Related Applications

Subject matter in the present application is included in Disclosure Document No. 403212, filed on August 1, 1996.

Background of the Invention

This invention relates generally to the field of telephony, and more particularly to an apparatus integrating voice recognition, cellular phone technology and telephone headsets.

Presently, a plurality of headset devices are available for use in a typical PBX or telephone system. A variety of such headsets are disclosed in the Hello Direct Catalog, Spring 1997, and in U.S. patent 4,882,745 to Silver. In U.S. patent 5,487,102 to Rothschild, Ralph F., et al., a headset interface is disclosed that is connected to the public telephone network at a central office. The system includes automated voice features that alleviates the need for an operator to vocalize greetings and responses to users of the telephone system. This system relies upon standard ground-line based telephony, rather than cellular technology.

Cellular technology has been widely applied to car telephone systems. For example, a standard car mounted cell phone with a keypad on the hand set is disclosed in U.S. patent 5,335,261 to Fujinaka. Dialing a phone number via the keypad is awkward and potentially unsafe while operating a moving vehicle. Even when the portable phone is removed from the vehicle-mounted base, the cell phone mounted keypad still presents the same difficulties to dialing while a person is in motion or in an environment where being visually distracted can be problematic. The cell phone system in the '261

Patent includes a speaker phone feature that frees a driver from having to hold the phone in the car, but this feature only adds marginally to the overall convenience and safety of the device.

Telephone headsets have been proposed for use with cellular systems, such as the system disclosed in U.S. patent 5,191,602 to Regen et al. The headset shown in this patent fails to eliminate many of the problems of using a cellular device. For example, when using the cellular phone in an automobile, the driver is required to be connected to a slave unit containing electronic circuitry that purports to provide a transparent interface between the headset and the existing cell phone. With this system, the headset is directly connected by a cord to the cellular device. Moreover, as with a standard car phone, the user of the headset shown in the '602 Patent is still required to dial using the keypad on the cellular device.

So-called "wearable" cellular phones have been recently promoted. One such compact telephone can be worn as a necklace around the neck. The device described in the article is not useable when being worn. Additionally a conventional extendable antenna is required along with a keypad for dialing. This invention is consistent with the current state of the art devices that require the user to use their hands to operate the device.

In U.S. patent 5,042,063 to Sakanishi, a telephone apparatus is disclosed in which a call may be made in response to utterances of a user by speech recognition without manually dialing a telephone number. However, the system still requires some keypad functions in order to communicate, so that is does not permit true hands free operation.

Summary of the Invention

In view of the limitations of the prior communication systems, the present invention contemplates a highly flexible headset communication apparatus. The headset apparatus is self-contained, meaning that it includes its own power source, communications link and circuitry to maintain remote, non-land based communications. In one application, the headset apparatus of the present invention permits use with a base unit linked to an office or landline telephone system. The same headset can be used for remote cellular communication outside the office.

In one embodiment, the headset apparatus includes a port and circuitry for I/R communications with external hardware. For example, in one mode of operation, the user can send and receive data to and from a personal computer, or an ATM.

In one important feature of the invention, the headset is provided with electronics/software for voice recognition. The headset permits voice activation of the headset, voice dialing and audible commands. The apparatus includes electronics to recognize whether the user has issued a voice command, to determine the nature of the audible command, and to control the operation of the headset in response to the spoken word. In one embodiment, the headset apparatus can distinguish between spoken numbers and spoken words. The headset includes electronics to permit spoken number dialing, and to access a database of telephone numbers referenced by spoken words.

In conjunction with the voice recognition features, the headset includes electronics and software for user recording of voice commands. A voice recognition processing unit (VRPU) within the headset processes verbal input and stores a translated version of the spoken words in a local memory. The VRPU can then compare future spoken commands with the translated version in memory to then issue an appropriate electronic command to the headset components.

In one beneficial feature of the invention, advanced antenna technology incorporated into the headset. The advanced antenna overcomes interference and signal degradation that is typically associated with cellular communications. A renewable power supply, such as a rechargeable lithium battery, adds to the flexibility of the inventive telephone headset.

In another feature of the invention, the headset includes a mouthpiece that is rotatably connected to the central housing of the apparatus. The mouthpiece includes a housing end that fits within a complementary configured recess in the housing. An array of electrical contacts are disposed on both the housing recess and the housing end of the mouthpiece. The electrical contacts transmitted electrical energy between the components in the central housing and the components in the mouthpiece, such as the ear speaker and microphone. In addition, the headset apparatus can be energized or de-energized by rotating the electrical contact arrays into and out of electrical connection.

In one feature associated with the rotatable mouthpiece, the electrical contacts at the housing end are arranged to contact corresponding electrical contacts on the base unit. With the mouthpiece rotated into a position in which the headset is not energized by its own power supply, the headset can be linked to the base unit. The base unit can be used to recharge the on-board power supply of the headset. In addition, the base unit can be used to maintain communication through the headset speaker and microphone.

It is an object of the present invention to provide a highly integrated wearable cellular telephone apparatus that is incorporated into a headset. Having the power source, control circuitry and antenna built in to the headset offers a significantly compact and portable communication device that can be operated safely in or out of a vehicle or the office.

It is a further object of the invention to provide a wearable

communication system which reduces need for having a separate phone device for your vehicle, home, office or other locations to be fixed. Features of the system allow connection to a PBX or use as a remote stand-alone cellular phone.

It is further an object of the present invention to function with a wireless infrared communication port to transmit data from a computer laptop or other device and to forward the data via the cellular network to other computers or systems.

One benefit of the present invention is achieved by features of the wearable headset that permit voice activated commands. Other objects and advantages will become apparent from a consideration of the ensuing description and accompanying drawings.

Description of the Figures

FIG. 1 is an exploded perspective view of the components of a cellular headset according to one embodiment of the present invention.

FIG. 2 is a partial exploded view of the electrical contacts between the mouthpiece and the electronics housing.

FIG. 3 is a top perspective view of a base unit for use with the cellular headset shown in **FIG. 1**.

FIG. 4 is a side elevational view of the headset shown in **FIG. 1** mounted on the base unit shown in **FIG. 3**.

FIG. 5 is a diagrammatic representation of the electronic components of the cellular headset shown in **FIG. 1**.

FIG. 6 is a generalized flowchart of the functions performed by the electronics diagrammed in **FIG. 5**.

FIG. 7 is a detailed flowchart of one step shown in the flowchart of **FIG. 6** for executing voice commands.

FIG. 8 is a detailed flowchart of a further step shown in the flowchart of **FIG. 6** for executing recording commands.

FIG. 9 is a detailed flowchart of another step shown in the flowchart of **FIG. 6** for executing voice-activated controls.

Description of the Preferred Embodiment

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to one preferred embodiment illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated embodiment, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

In accordance with one embodiment of the invention, a telephone headset **10** is provided with a headband **12** configured to be supported on the head of a user. The headband **12** is attached to an electronics housing **14** that contains electronic components used with the telephone headset **10**. The electronics housing **14** pivotally supports a movable mouthpiece **16** that is configured to wrap around from the side of the face of the user to the front adjacent the user's mouth. The mouthpiece **16** includes a microphone **18** that is mounted at the end of the mouthpiece. Thus, it should be apparent that the mouthpiece **16** is configured so that the microphone **18** can be disposed immediately adjacent the mouth of the user. In one specific embodiment, the microphone **18** is a sub-miniature condenser microphone having an even cardioid unit directional response over the speech bandwidth. In this specific embodiment, the microphone **18** assures extremely low sensitivity to mechanical vibration and reduces handling noise as the mouthpiece **16** is manipulated. In a further specific embodiment, the microphone **18** can include a back-electret element and an integral preamplifier for a refined and accurate signal.

The telephone headset **10** further includes an ear speaker **20** that is engaged within the mouthpiece **16** at the opposite end from the

microphone **18**. An ear cushion **21** is provided so that the microphone can be supported and seated against the ear of the user. The headband **12** is provided in adjustable sections. The band includes a fixed section **12a** that is attached to the electronics housing **14**. A strap **12b** extends from the fixed section and is adjustably engaged by a movable section **12c**. In this respect, the headband **12** can be of a conventional design to permit adjustment to accommodate the head of the user. The movable section **12c** can be provided with a counterweight at its free end to balance the weight of the headset components on the user's head.

In the preferred embodiment, the fixed section **12a** is engaged to the electronics housing **14** by way of a pair of attachment pins **25** and corresponding attachment recesses **26**. In the illustrated embodiment, the pins **25** are shown as extending from the electronics housing **14**, while the recesses are disposed within the fixed section **12a** of the headband **12**. Of course, the pins and recesses can be reversed in their location. In this embodiment, the pins are configured for removable press fit engagement within a corresponding recess to firmly hold the headband **12** and electronics housing **14** together.

In one feature of the invention, the telephone headset **10** is provided with an antenna **22** that is disposed within the headband **12**, and preferably the fixed section **12a**. In one specific embodiment, the antenna **22** can utilize advanced strip technology to reduce the profile of the antenna to fit within the headband **12**. Two sets of mating contacts **28** and **29** are respectively connected to the headband **12** and electronics housing **14**. These contacts provide electrical connection between the antenna **22** and electronics disposed within the electronics housing **14**.

Looking again at the mouthpiece **16**, a housing **34** is provided adjacent the speaker **20**. The housing preferably includes means for supporting the speaker **20** at one face of the housing (not shown). The

housing **34** further defines a battery compartment **35** for receiving battery cells **40**. Preferably, the batteries **40** are capable of providing five volts DC power to the electronics of the telephone headset **10**. In specific embodiments, the batteries can be standard lithium disk cells, as depicted in **FIG. 1**. In an alternative embodiment, the disk cells can be replaced by a conformal battery that is configured to fit within the electronics housing **14** or a component of the headband **12**.

The electronics housing **14** defines a hinged recess **37** within which the housing **34** of the mouthpiece **16** can rotatably reside. The electronics housing **14** further provides a compartment for housing a cellular communication electronics component **30** and a headphone control electronics component **32**. Preferably, these two components **30, 32** are standard integrated circuit boards carrying the various electronic components for the appointed functions.

The battery compartment **35** of the housing **34** is closed by a cap **42**. The cap **42** includes a cylindrical hinge portion **43** that is preferably configured to be pressed into the battery compartment **35**. In a specific embodiment, the hinge portion **43** and the battery compartment **35** can form a circumferential pivoting hinge, such as a ridge and groove configuration, so that the mouthpiece **16** can be pivoted in the direction of the arrow A about the hinge portion **43**.

The cap **42** further includes an attachment plate **44** providing a means for supporting the hinge portion **43** relative to the electronics housing **14**. The attachment plate **44** can include a plurality of pins **45** that are adapted to be press fit into corresponding recesses **47** defined in the electronics housing **14**. The attachment plate **44** is configured so that the housing **34** pivots in close proximity and preferably direct contact with the hinge recess **37** of the electronics housing **14**. It is understood that the cap **42**, with its hinge portion **43** and attachment plate **44**, is one manner for pivotably supporting the mouthpiece **16** relative to the electronics housing **14**. Other hinge type supports are

contemplated, provided that they maintain a direct pivoting contact between the housing **34** and the hinge recess **37**.

The importance of this direct contact can be appreciated with reference to the electrical contact array **50** that is disposed on the outer portion of the housing **34**. This contact array **50** is in direct electrical connection with a corresponding contact array **60** mounted to the surface of the hinge recess **37** of the electronics housing **14**. The relationship between the two contact arrays **50** and **60** are shown in the detailed view of **FIG. 2**. The contact array **50** can include individual electrical contacts $\mathbf{50_A}$-$\mathbf{50_E}$ (note that contact 50e is hidden from view in **FIG. 2**). A corresponding number of contacts $\mathbf{60_A}$-$\mathbf{60_E}$ are provided in the array **60** in the electronics housing **14**. In a specific embodiment, the contacts $\mathbf{50_A}$ and **60A** can correspond to an electrical interface with the microphone **18**. The contacts $\mathbf{50_B}$ and $\mathbf{60_B}$ provide volume control, while the contacts $\mathbf{50_C}$ and $\mathbf{60_C}$ are the electrical connections for the speaker **20**. The final pair of contacts in each array is power contacts.

Each of the electrical contacts in the two arrays **50** and **60** can be of conventional design that provides for direct sliding contact. In one specific embodiment, the contacts $\mathbf{60_A}$-$\mathbf{60_E}$ can be somewhat elongated around the innercircumference of the hinge recess **37**. In this manner, direct electrical connection with the corresponding contact $\mathbf{50_A}$-$\mathbf{50_E}$ can be maintained even as the mouthpiece **16** is pivoted relative to the housing **14**.

The telephone headset **10** can include a pair of volume control buttons **52** and **54** mounted to the mouthpiece **16**. The pushbutton switches can be used to increase the volume heard through the speaker **20**. Signals from the volume control switches are passed to the headphone control electronics component **32** by way of the electrical contacts $\mathbf{50_B}$ and $\mathbf{60_B}$. Similarly, signals from the microphone **18** are passed to the electronics component **32** through the contacts $\mathbf{50_A}$ and

60_A, while signals travel to the speaker **20** by way of the electrical contacts 50_C and 60_C.

The electronics housing **14** can carry an array of visual indicators. For example, a power indicator **56** can be provided to indicate that the phone headset is activated. This activation occurs when the mouthpiece **16** is pivoted relative to the electronics housing **14** so that the power electrical contacts $50_{D,E}$ engage the contacts $60_{D,E}$. When the headset **10** is in use for telephone communication or other type of data transmission, a busy indicator light **58** can be illuminated by circuitry within the electronics component **32**. In the case of both indicators **56** and **58**, a low-power LED can be utilized. In other specific adaptations, the LEDs can be illuminated in different colors to provide different indications. For example, the power LED **56** can be red when the telephone headset **10** is activated, and green when the batteries **40** are low on charge. Similarly, the in use LED **58** can be illuminated red when the user is making use of the headset **10** and can be illuminated a flashing green when an incoming call is being received by the unit. Of course it is understood that both the electronics housing **14** and the mouthpiece **16** can be provided with other visual indicators, such as the LEDs **56** and **58**, to act as annunciators for various functions of the telephone headset **10**.

A further component of the present invention is the base unit **70** shown in **FIG. 3**. The base unit **70** can include a power input **71** which can provide for connection to an AC source of power. The unit also includes a retractable and extendable antenna **72** to provide a communication link to the telephone headset **10** by way of the antenna **22**. The base unit can also include a microphone **74** and a speaker **75** to establish two-way communication between the base unit and a variety of telephone headsets **10**. Two volume control switches **76** and **77** can also be provided to adjust the volume of the signal received over the speaker **75**.

In one feature of the invention, the base unit **70** provides a means for supporting and providing electrical contact with the telephone headset **10**. Specifically, an array of contacts **80_A-80_E** is provided within a support recess **81** defined in the top face of the base unit **70**. The support recess **81** is configured to receive a portion of the housing **34** of the mouthpiece **16**, in a manner shown in **FIG. 4**. In this configuration, the mouthpiece **16** is pivoted upward in the direction of the arrow A in **FIG. 1** so that the arm of the mouthpiece substantially overlies the electronics housing **14**. In this orientation, the electrical contact array **50** is exposed beneath the telephone headset **10**. When the headset **10** is mounted within the support recess **81**, the electrical contact array **50** is exposed to and in electrical contact with the corresponding electrical contacts in the base unit **70**. Thus, the corresponding contacts **50_A, 50_B** have complimentary mating contacts **80_A, 80_E** within the base unit. The power and ground contacts **80_D** and **80_E** of the base unit are used to provide a recharging capability for the batteries **40** of the telephone headset **10**. Thus, in this instance, the batteries **40** are preferably rechargable lithium type batteries. When the telephone headset **10** is mounted within the base unit **70** for recharging, an indicator light **82** can be illuminated to shown the recharging function is occurring. With the telephone headset **10** mounted to the base unit **70**, the microphone and speaker of the telephone headset **10** are electrically connected to the base unit, rather than to the control electronics component **32** of the telephone headset **10**.

In further features of the base unit **70**, a display **84** can be provided for various messages. Circuitry within the base unit **70** can provide messages on the display **84** to indicate the origination of an incoming call, the duration of a call, and other information of interest.

So that the base unit **70** can operate within a telephone system, it is provided with a jack **85** for engaging a conventional telephone ground wire. This jack **85** can be an RJ45 jack as is known in the art.

In addition, the base unit **70** is provided with a serial interface jack **86** that can be engaged by a serial cable to a data source, such as a personal computer. In this respect, the base unit **70** can be used to transmit serial data to a telephone headset **10**. To effect this function, the base unit **70** includes an I/R interface **88** that can transmit an infrared signal to a telephone headset **10**. The headset **10** can therefore be provided with a corresponding I/R interface **89**, located on the underside of the mouthpiece **16**. Circuitry within the headphone control electronics component **32** can be used to receive and condition signals transmitted via the I/R interfaces **88** and **89**. In this aspect, the signals can pass from the mouthpiece **16** to the electronics housing **14** though the microphone contacts $\mathbf{50}_A$ and $\mathbf{60}_A$.

It is understood that the I/R port **89** in the telephone headset **10** can be situated in a variety of locations on the headset. In addition, multiple I/R ports can be provided for greater ease of use of this communication aspect. If properly located on the headset, the I/R ports provide means for headset-to-headset communications. The I/R port **89** can also provide an interface to I/R ports on other data transmission devices, such as computers, printers, ATMs and the like. Using components of the headset described herein, a user can enable half or full-duplex communication with a computer or peripheral device. The I/R port can transmit verbalized commands that have been translated using speech synthesizer technology, to control the computer or peripheral.

Referring now to **FIG. 5**, the general electronics of the telephone headset **10** are depicted diagramatically. As indicated above, the telephone headset **10** includes a cellular communication electronics component **30** that includes circuitry for receiving and processing cellular communications over the antenna **22**. In one specific embodiment, the cellular component **30** is integrated with RF interface control circuitry **90** that provide for reception and transmission of RF

signals over the antenna **22**. Such RF control circuitry **90** is well known in the art, as is the electronics necessary for the cellular interface, as part of the cellular communication electronics component **30**. Again, as indicated above, this component is provided as an integrated circuit board or wafer that is configured to be mounted within the electronics housing **14** of the telephone headset **10**. The cellular communication component **30** also controls a ring indicator **92**. The ring indicator can be a typical electro-mechanical device that provides an audible sound when a cellular telephone transmission is being received at the antenna **22**. The indicator **92** can also constitute or include a vibratory indicator that vibrates when an incoming call is received

Signals processed by the cellular interface component **30** are transmitted to the headphone control electronics component **32** for additional processing and transmittal to and from the microphone **18** and speaker **20**. The electronics component **32** is powered by a battery **40**, with the control electronics component **32** distributing power to the remaining electrical components of the telephone headset **10**.

The headphone control electronics component **32** can be provided with a separate power on/off switch **95** (not shown). However, most preferably, the power on/off switch **95** is integrated with the contacts $\mathbf{60_D}$ and $\mathbf{60_E}$. When the power circuit is completed through the contacts $\mathbf{50_D}$ and $\mathbf{50_E}$ of the mouthpiece **16**, the power switch **95** is activated. In this instance, a signal is provided to the electronics component **32**, which then illuminates the appropriate LED indicator **56, 58.** When the telephone headset **10** is mounted on the base unit **70**, the control electronics **32** can also be used to drive the LED display **84** mounted to the base unit **70**. In addition, the telephone headset **10** can be provided with I/R interface circuitry **97** that process I/R signals through the control electronics component **32**.

In one important aspect of the invention, the microphone **18** and speaker **20** are electrically connected to the control electronics

component **32** by way of a voice recognition processing unit **100**. The VRPU **100** can be provided with an optional RAM memory **101** for storing a variety of voice recognition information, as described in more detail below. The VRPU **100** provides an important benefit to telephone headset **10** of the present invention. Specifically, the VRPU can translate audible instructions into electronic instructions to direct the mode of operation of an activity of the telephone headset **10**. In this way, the telephone headset **10** is truly a hands-free cellular telephone, in contrast to the traditional prior cellular phone that utilizes a keypad for data entry.

The voice recognition processing unit **100** can include a number of application specific integrated circuits (ASIC) to perform a variety of voice recognition functions. For example, one ASIC can be utilized for electronic dialing. This particular ASIC is configured to recognize spoken numbers corresponding to a telephone dialing command. A second ASIC can provide for general speech recognition to recognize specific commands used to operate the telephone headset. A third ASIC can provide means for programming the memory **101** of the VRPU **100** to store various spoken numbers and word commands. A further ASIC can process a variety of spoken instructions for controlling certain functions of the telephone headset **10**. Each ASIC includes circuitry for recognizing and processing spoken numbers and words and providing an appropriate signal to the headphone control electronics component **32** for subsequent electrical processing.

The VRPU **100** can also include voice recognition ASICs that permit the headset to "speak" to the user. For example, when an incoming call is received by the cellular interface unit **30**, a signal can be generated by the VRPU directing speech simulation software to send an audible, spoken message to the speaker **20**. For instance, the message can be the words "You have a call". Other spoken messages

can be generated by the headset VRPU **100** depending upon the headset activity.

In one specific embodiment, the electronics of the control electronics component **32** and the VRPU **100** execute a sequence of general instructions as shown in **FIG. 6**. When power to the unit is activated in the initial step **110**, the power on indicator LED is illuminated in step **112**. In the subsequent steps **114**, **116** and **118**, the various electrical components of the telephone headset **10** are activated, specifically, the mouthpiece **16** is activated at the hook on step, the microphone in the next step, and the volume controls in step **118**.

In the following steps **120, 122** and **124**, a command recognition ASIC within the VRPU **100** determines whether a spoken command is given corresponding to one of the three illustrated functions. Specifically, the recognition ASIC determines whether a voice dial command is being requested in step **120**, a recording command is issued in step **122**, or further telephone headset control commands being expressed in step **124**. If no audible commands are issued, the telephone headset **10** goes into a standby mode **126**. The standby mode is controlled by the control electronics component **32** which permits reduced power usage while keeping the telephone headset **10** activated to receive incoming calls. Once an incoming call is received by the cellular interface component **30**, the incoming signal awakes the control electronics component **32** so that full power can be supplied to the remaining electronics of the telephone headset **10**.

Referring now to **FIG. 7**, a flowchart of commands executed by a dialing ASIC within the VRPU **100** is illustrated. If a voice dial command is issued in step **120 (FIG. 6)**, control is passed to the dialing ASIC which is placed in step **130** in a ready mode to receive a dial command. This control transfer can be initiated by an audible command such as "dial" which is recognized by the command control ASIC. Once control

is passed to the dialing ASIC, a determination is made as to whether the next verbal intonation by the user is a number or a word command. A test is conducted in step **132** to determine whether the spoken input is a number command. Thus, the dialing ASIC **66** will include an array of recognized numbers as spoken by the particular user, i.e. "one", "two", etc. If the dialing ASIC recognizes a number, control passes to step **134** in which the spoken number is converted to an electronic dialing command to dial the spoken number. Once the number has been dialed, the voice dialing sequence is turned off in step **136** so that any further spoken numbers by the user will not be interpreted as a dialing command. At this point, direct voice communication can be conducted by the user through the telephone headset **10**. In an optional step **138**, a voice synthesizer within the VRPU **100** can be activated. The voice synthesizer can issue audible requests through the speaker **20**. For example, in step **140**, the voice synthesizer can request whether any new numbers need to be dialed by the dialing ASIC. If the answer is yes, then control passes back to step **134** in which the number is spoken by the user and dialed by the dialing ASIC. The voice synthesizer can further request in step **142** whether the user is finished with the current conversation. If the enunciated answer is yes, then control passes to the standby mode at step **144**.

Referring back to the beginning of the flowchart in **FIG. 7**, if a number command is not issued to the ASIC in step **132**, control passes to step **150**. In this step it is determined whether a word command is being issued that is recognized by the VRPU **100**. If no word is uttered, control passes down to step **160**. On the other hand, if a word dialing command is issued in step **150**, control passes to the next step **152** in which the spoken word is looked up within the memory **101**. At this instance, the word command can simply be the name of a person to be called. This name can be stored within a look-up table in the RAM memory **101** to be accessed by the VRPU **100**. The dialing ASIC determines a match between the spoken word and the stored word, and

the appropriate telephone number is electronically extracted from the memory **101**. In the next step this number is passed to the control electronics component **32** to perform the dialing function. As with the branch corresponding to number commands, the voice dialing activation is turned off in step **156** and the voice synthesizer activated in step **158**. In step **160** the dialing ASIC requests whether the user is done with the conversation, and if the answer is yes the telephone headset **10** is passed to the standby mode in the final step **162.**

When the telephone headset **10** is first activated by a user, it must be educated as to the user's voice. Thus, if no voice dialing commands are being issued in the flowchart of **FIG. 6**, then the next step **122** is used to determine whether any record commands are being issued by the user. If so, then control passes to the recording ASIC whose executed steps are shown in **FIG. 8**. In this step, the voice activated recording commands are turned on in step **170**. In the next step **172**, the recording ASIC determines whether any recordable voice signals are being received. If so, it is determined in step **174** whether the next spoken words are to be recorded. If so, the user speaks the words and they are stored within the memory **101** in step **176**. If the user desires to change the particular recorded words, the last entered information can be erased in step **178**. In the following step **180**, it is determined whether any new recordings are to be made. If not, control passes to step **182** in which the telephone headset **10** is placed in the standby mode.

Referring back to **FIG. 6**, step **124** determines whether any specific control commands have been issued by the user. If so, then the control command ASIC is activated to follow the steps shown in **FIG. 9**. Once the control command ASIC is activated in step **185**, it is determined whether any new commands have been issued by the user in step **187**. If so, the voice command is received in step **189**, and the memory **101** is searched in step **190** to find a match for the particular

voice command. In one specific embodiment, these commands can be to activate various RF controls in step **192** or to activate I/R controls in step **194**. Depending upon which controls are activated, the spoken voice command is converted to an electronic signal which is then passed to the appropriate control in step **196**. After the control signals have been received by either the RF or I/R control circuitry, the corresponding controls are deactivated in steps **198** and **200**. If no further commands are received in step **202**, the telephone headset **10** passes to the standby mode in step **204**. The audible commands executed by the command control ASIC according to the steps in **FIG. 9** can correspond to commands for tuning the RF reception of the telephone headset **10** to a particular base unit **70**. In addition, when I/R controls are activated, the commands can give effect to various data transmissions over the I/R channel between the base unit **70** and the telephone headset **10**. In some cases, the I/R channel can be used to transmit data to the base unit **70** and through the serial interface **86** to a personal computer. Such data can be spoken words processed through speech synthesizer software to be downloaded to the PC, for subsequent transcription, for instance.

The present invention provides the user with a highly flexible communications device that is not constrained by conventional telephone system limits. For example, the headset **10** can be used in the office and integrated into the local PBX system through the base unit **70**. The base unit can be programmed to communicate with the headset on a cellular frequency. The headset allows the user to receive or continue a call anywhere in the office. The same headset can be used for remote cellular communication outside the office. The microprocessor **30** of the headset can issue commands to the cellular interface unit **30** to recognize when the unit is being used as part of the office telephone system and as a remote cellular unit.

The I/R port **89** adds a further dimension to the flexible communications achieved by the present invention. The I/R port permits communication that is not frequency dependent. In other words, while RF or cellular communication requires a unit specific address frequency, I/R communication requires no such limiting address. Thus, two headsets can communicate with each other, or a single base unit **70** can issue broadcast communications over the I/R band. Again, the microprocessor **30** of each headset can include software to recognize that an I/R transmission is being received. Various transmission protocols can be implemented to enable the headset to awake from a standby mode and activate the appropriate IR interface circuitry. If security is an issue, the I/R transmission packets can include password information recognizable only by a specific headset.

While the invention has been illustrated and described in detail in the foregoing drawings and description, the same is to be considered as illustrative and not restrictive in character, it being understood that only preferred embodiments thereof have been shown and described and that all changes and modifications that come within the spirit of the invention are desired to be protected.

What is claimed is:

1. A wearable communication apparatus comprising:

a mouthpiece having a first end and a second end, and including a speaker disposed adjacent said first end and a microphone disposed adjacent said second end;

a central housing having a top end and a bottom end;

means between said first end of said mouthpiece and said bottom end of said central housing for pivotably mounting said mouthpiece to said central housing, said mouthpiece pivotable to a fist position in which said microphone is adjacent the mouth of a user of the apparatus;

a head-band connected to said top end of said central housing and configured for supporting the apparatus on the head of a user;

an antenna;

electronic communication means for sending and receiving signals through said antenna, for controlling said speaker in response to received signals and for transmitting signals from said microphone for broadcast over said antenna.

2. The wearable communications apparatus according to claim 1, wherein:

said mouthpiece includes a first electrical contact array at said first end, said contact array connected to at least said speaker and said microphone; and

said central housing including a corresponding second electrical contact array arranged to provide electrical connection with said first contact array when said mouthpiece is in said first position.

3. The wearable communications apparatus according to claim 2, wherein:

said mouthpiece contains a power supply; and

said first and second contact arrays include a number of contacts in electrical communication with said power supply when said mouthpiece is in said first position.

4. The wearable communications apparatus according to claim 1, wherein:

said electronic communications means includes a voice recognition processing unit connectable to said mouthpiece through said first and second contact arrays when said mouthpiece is in said first position,

said voice recognition processing unit operable to translate verbal utterances received by said microphone into electrical signals usable by said electronic communications means.

5. The wearable communications apparatus according to claim 1, further comprising a base unit, said base unit having means for connection to an existing telephone network, an antenna and means for transmitting signals from the existing network to the antenna for broadcast to said headset.

6. The wearable communications apparatus according to claim 5, wherein;

said base unit includes a third electrical contact array corresponding to said first contact array; and

means for supporting said mouthpiece when said mouthpiece is rotated to a second position in which said first and second contact arrays are not in electrical contact, whereby said first and third contact arrays are in electrical contact in said second position.

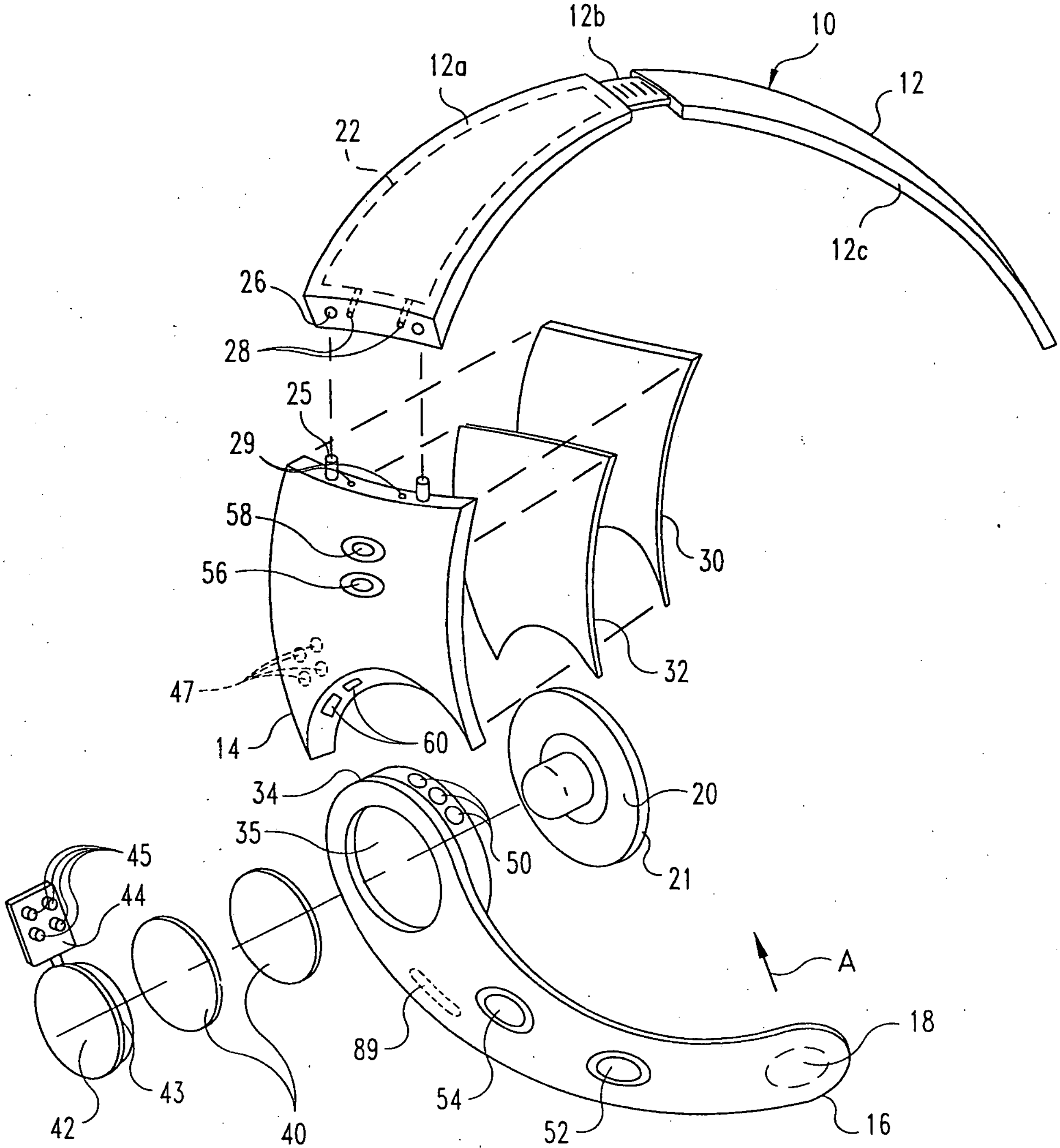
12b
10
12a
12
22
12c
26
28
25
29
58
30
56
32
47
14
60
34
20
35
50
21
45
44
A
18
89
43
54
52
16
42
40

Fig. 1

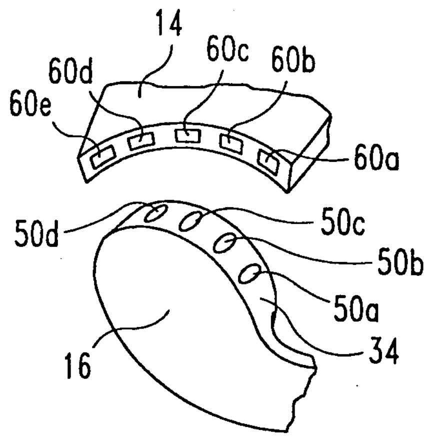

Fig. 2

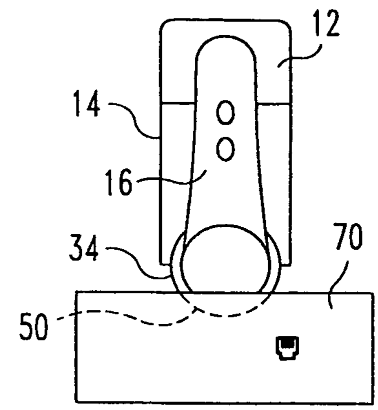

Fig. 4

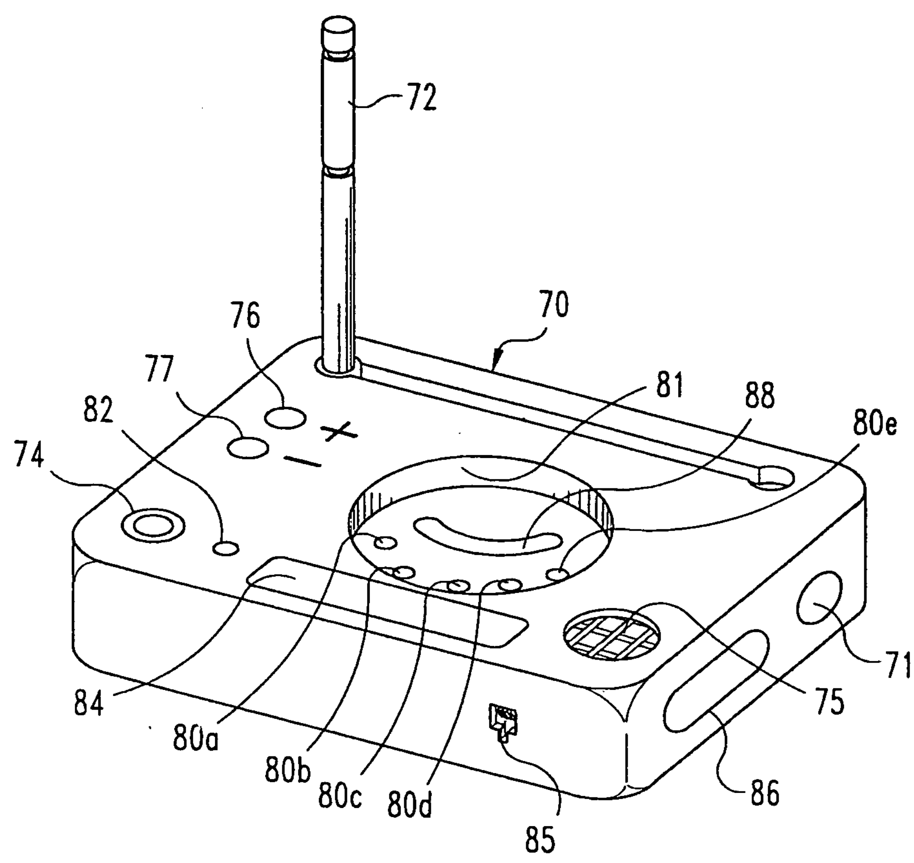

Fig. 3

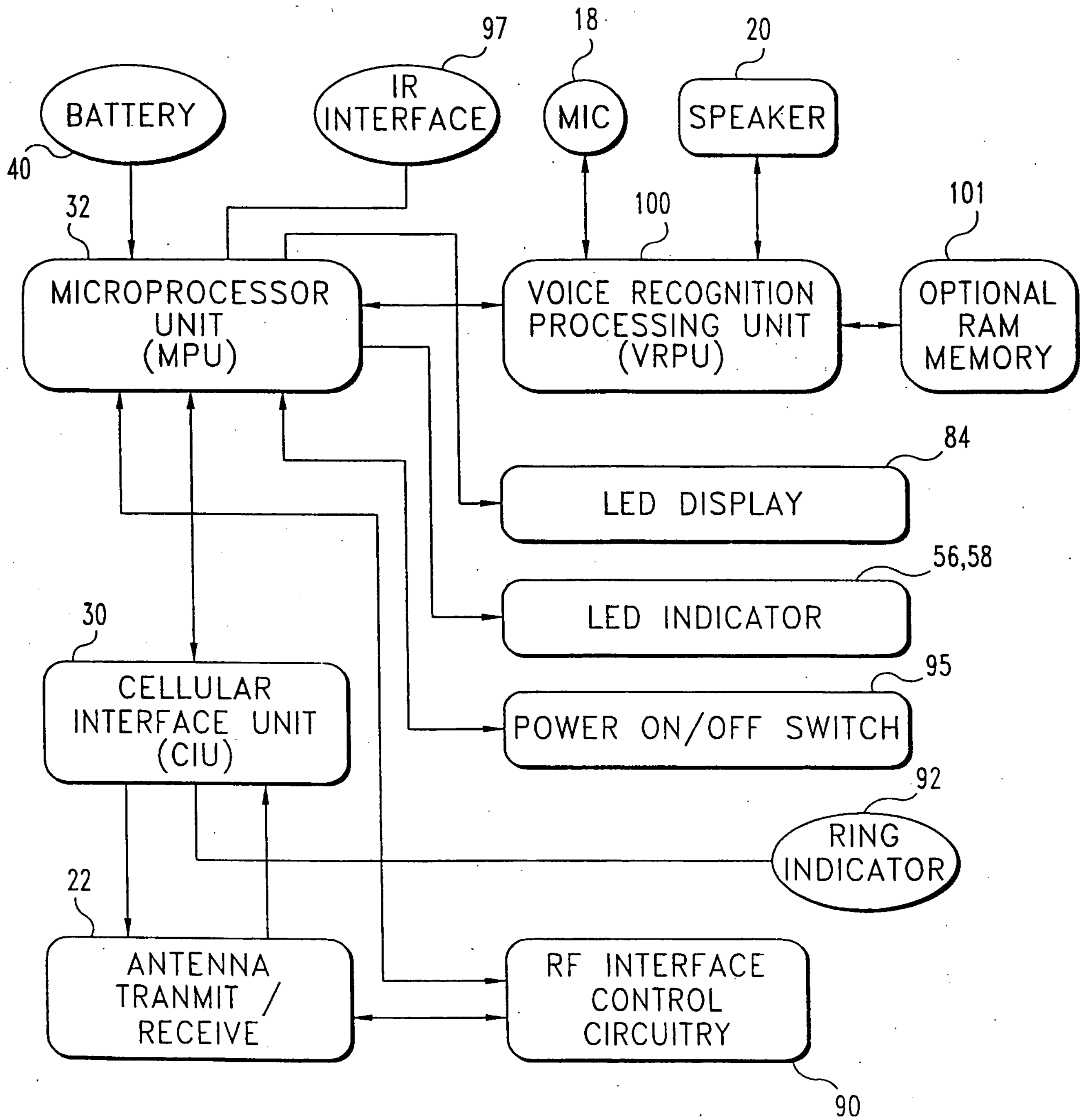
97
18
20
BATTERY
IR INTERFACE
MIC
SPEAKER
40
32
100
101
MICROPROCESSOR UNIT (MPU)
VOICE RECOGNITION PROCESSING UNIT (VRPU)
OPTIONAL RAM MEMORY
84
LED DISPLAY
56,58
LED INDICATOR
30
95
CELLULAR INTERFACE UNIT (CIU)
POWER ON/OFF SWITCH
92
RING INDICATOR
22
ANTENNA TRANMIT / RECEIVE
RF INTERFACE CONTROL CIRCUITRY
90

Fig. 5

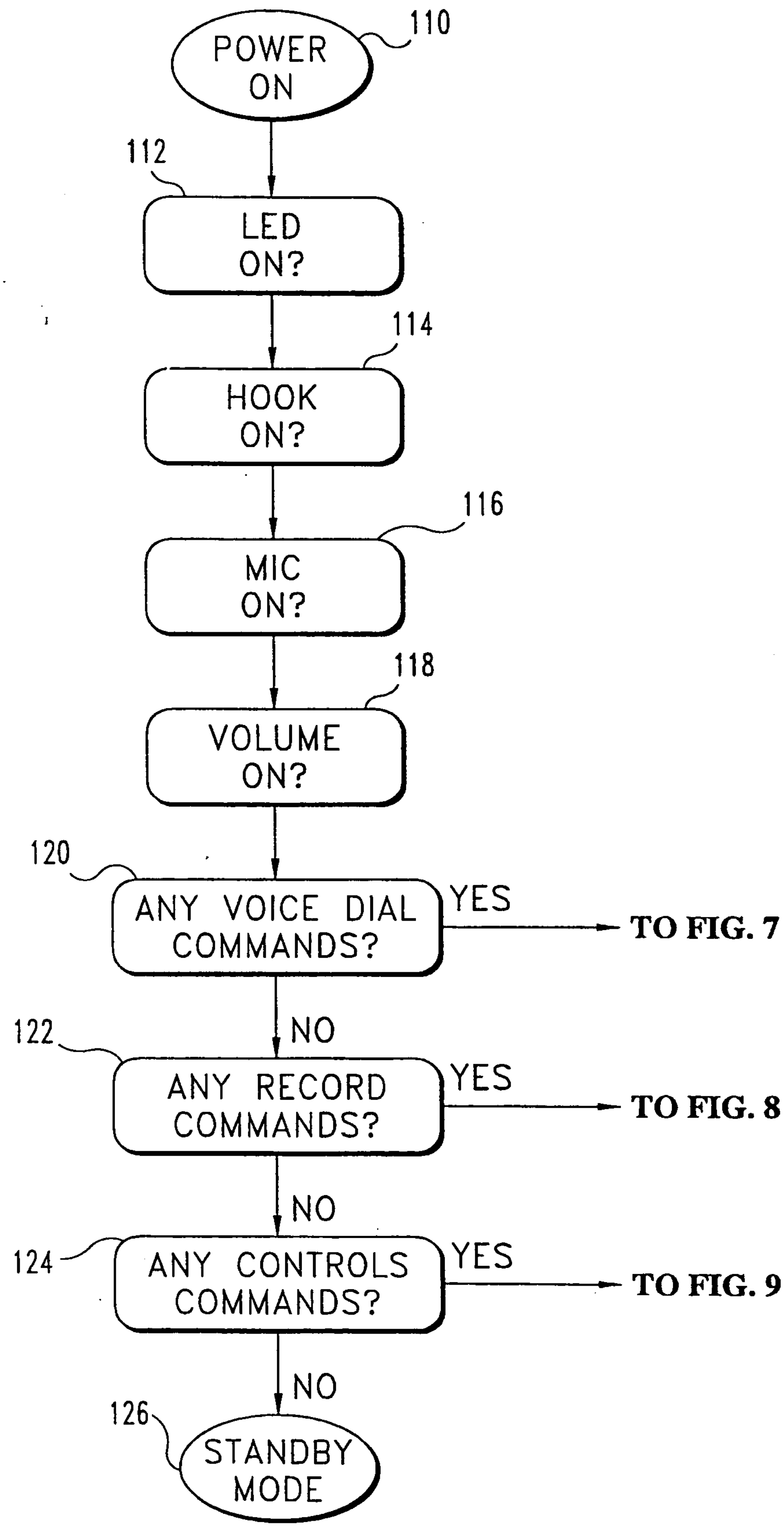
POWER ON
110
112
LED ON?
114
HOOK ON?
116
MIC ON?
118
VOLUME ON?
120
ANY VOICE DIAL COMMANDS?
YES
TO FIG. 7
NO
122
ANY RECORD COMMANDS?
YES
TO FIG. 8
NO
124
ANY CONTROLS COMMANDS?
YES
TO FIG. 9
NO
126
STANDBY MODE

Fig. 6

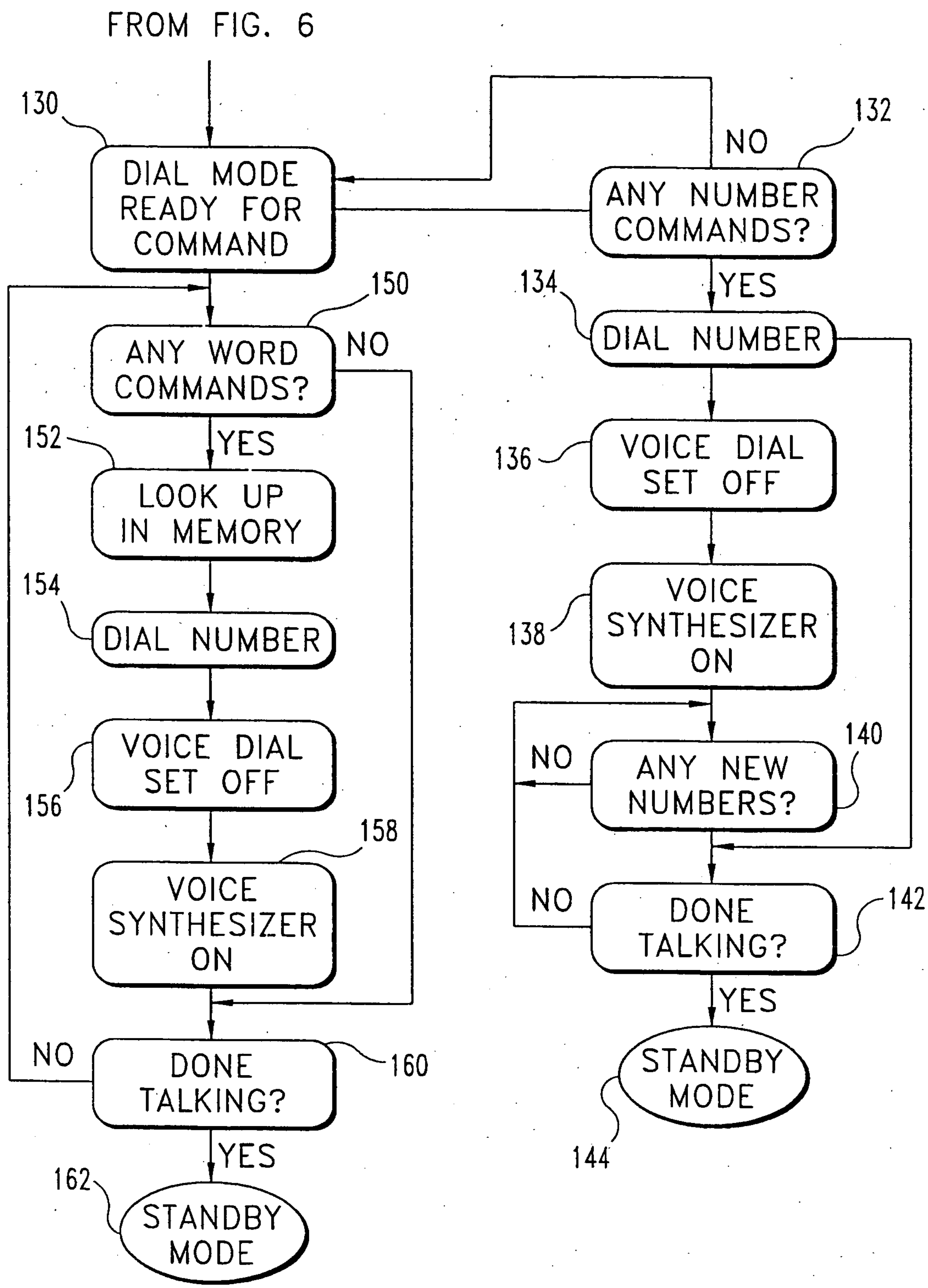
FROM FIG. 6
130
DIAL MODE READY FOR COMMAND
132
NO
ANY NUMBER COMMANDS?
YES
134
DIAL NUMBER
136
VOICE DIAL SET OFF
138
VOICE SYNTHESIZER ON
140
NO
ANY NEW NUMBERS?
NO
DONE TALKING?
142
YES
STANDBY MODE
144
150
ANY WORD COMMANDS?
NO
152
YES
LOOK UP IN MEMORY
154
DIAL NUMBER
156
VOICE DIAL SET OFF
158
VOICE SYNTHESIZER ON
NO
DONE TALKING?
160
YES
162
STANDBY MODE

Fig. 7

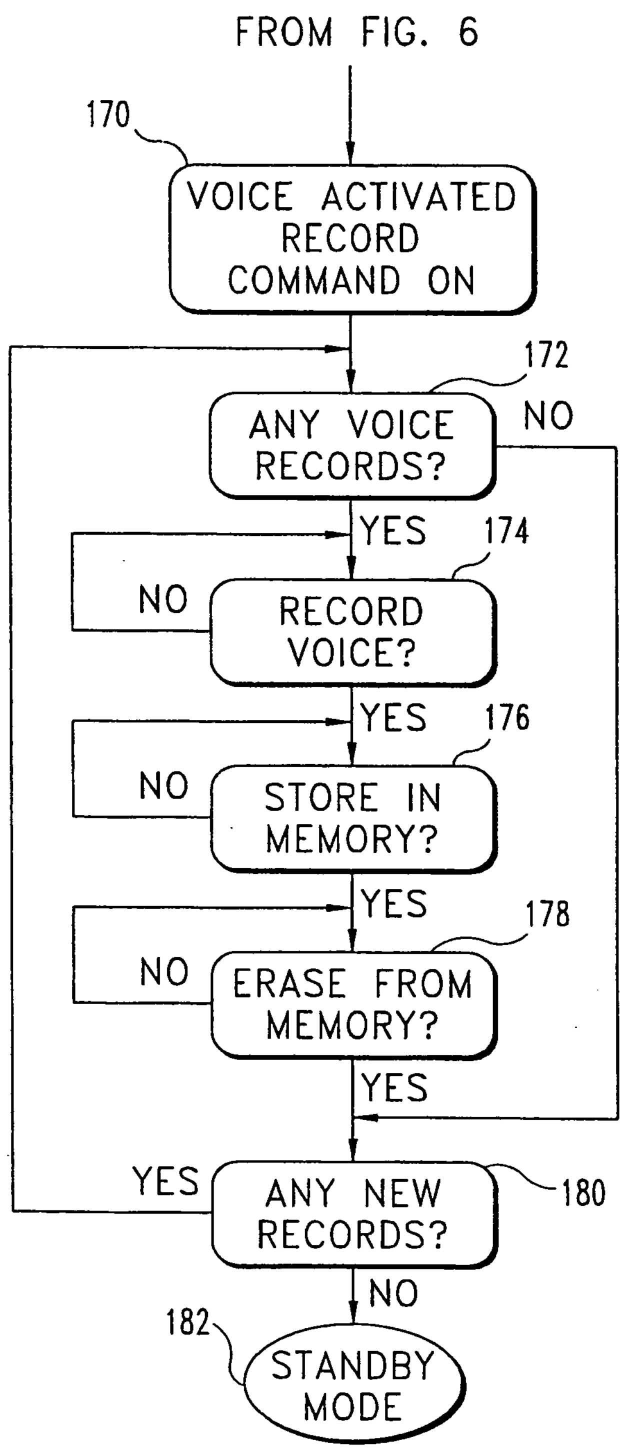
FROM FIG. 6
170
VOICE ACTIVATED RECORD COMMAND ON
172
ANY VOICE RECORDS?
NO
YES
174
RECORD VOICE?
NO
YES
176
STORE IN MEMORY?
NO
YES
178
ERASE FROM MEMORY?
NO
YES
ANY NEW RECORDS?
180
YES
NO
182
STANDBY MODE

Fig. 8

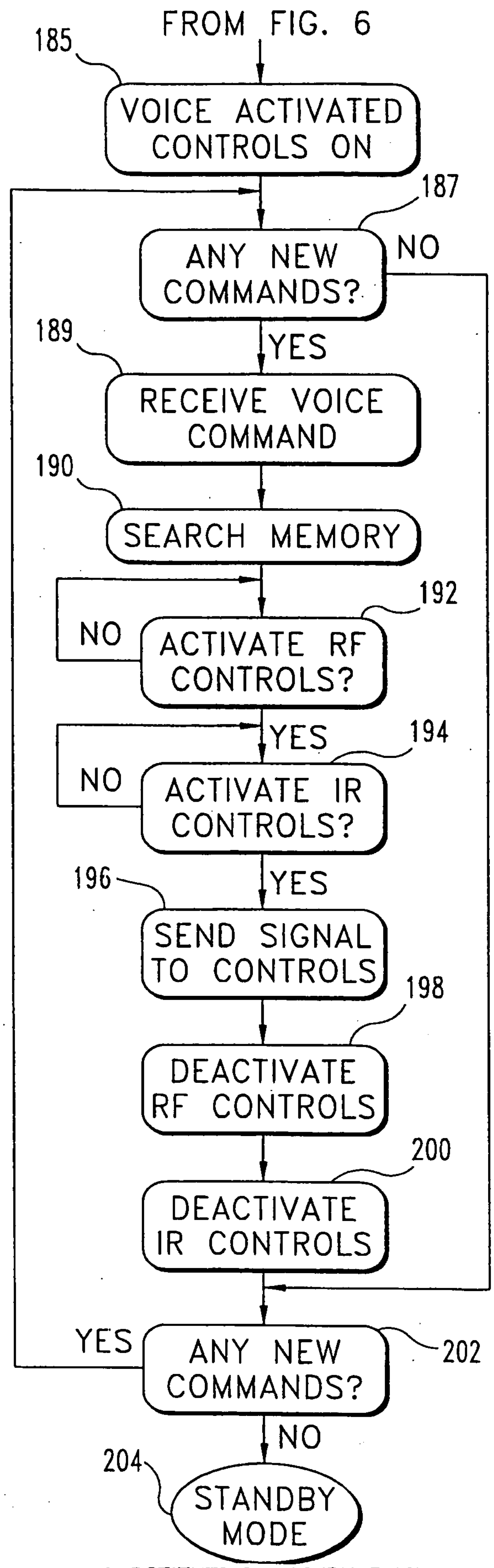
FROM FIG. 6
185
VOICE ACTIVATED CONTROLS ON
187
ANY NEW COMMANDS?
NO
YES
189
RECEIVE VOICE COMMAND
190
SEARCH MEMORY
192
NO
ACTIVATE RF CONTROLS?
YES
194
NO
ACTIVATE IR CONTROLS?
YES
196
SEND SIGNAL TO CONTROLS
198
DEACTIVATE RF CONTROLS
200
DEACTIVATE IR CONTROLS
YES
ANY NEW COMMANDS?
202
NO
204
STANDBY MODE

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/17421

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G10L 3/00
US CL :704/275
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 704/275, 455/79; 455/90; 379/61

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WEST, APS, STN, DIALOG

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 4,484,029 A (KENNEY) 20 November 1984 col. 2, line 27 - col. 4, line 5.	1-2 ---- 3-6
Y	US 4,945,570 A (GERSON et al) 31 July 1990, col. 4, lines 26-51	4
Y	US 4,882,745 A (SILVER) 21 November 1989, col. 3, line 49 - col. 4, line 14.	3, 5 and 6

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"B" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
09 SEPTEMBER 1999	20 OCT 1999

Name and mailing address of the ISA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Joni Hill ROBERT SAX
Facsimile No. (703) 305-3230	Telephone No. (703) 306-3017

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Date of the actual completion of the international search

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Date of mailing of the international search report

20 OCT 1999

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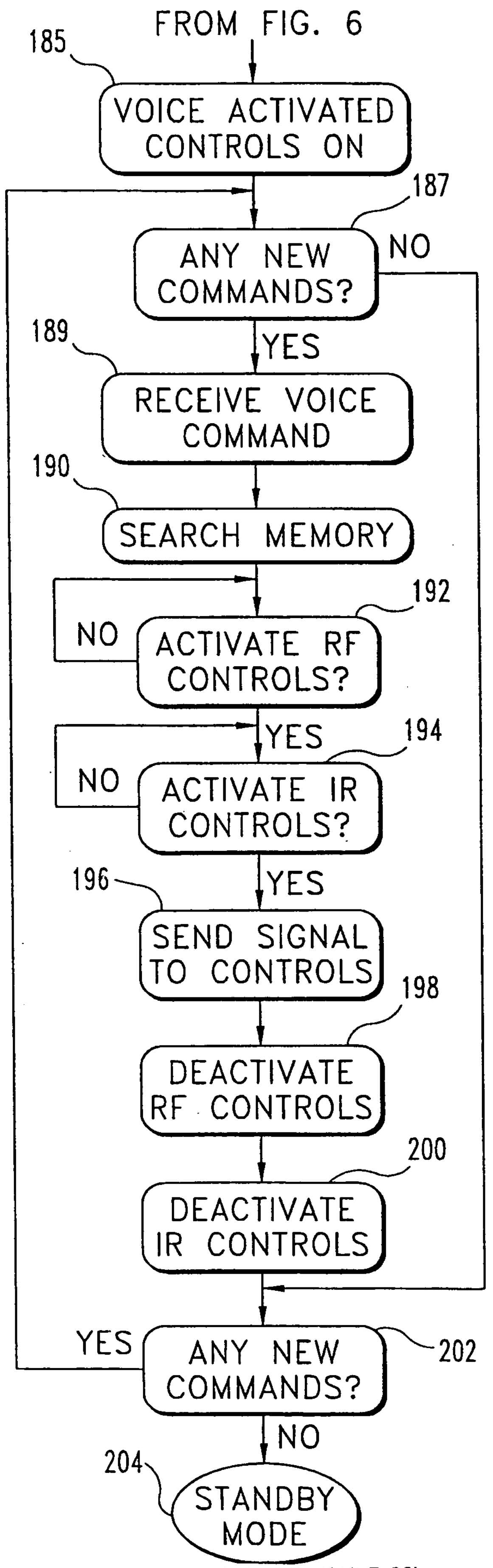
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VOICE ACTIVATED CONTROLS ON
187
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RECEIVE VOICE COMMAND
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ACTIVATE RF CONTROLS?
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ACTIVATE IR CONTROLS?
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SEND SIGNAL TO CONTROLS
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DEACTIVATE IR CONTROLS
YES
ANY NEW COMMANDS?
202
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204
STANDBY MODE

Fig. 9